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FARMERS' BULLETIN 1209  
UNITED STATES DEPARTMENT OF AGRICULTURE

# PLANTING AND CARE OF STREET TREES



**GOOD STREET TREES** provide a grateful shade and add to the value of near-by property. They also modify the undesirable effect on the nerves of the color of brick walls or other bright buildings.

Better results are to be expected with street trees if the municipality or other centralized authority does the planting and cares for the trees afterwards than by any other method. This is best accomplished by having an unpaid commission appointed for sufficiently long terms for the members to learn the needs of the work and give efficient service before their terms expire. The paid executive and experts should be employed by this commission.

Some of the funds should be provided by a small millage on the tax rate, the rest by appropriation, or else all by direct assessment collectible with the other taxes.

Plans should be made for the planting, using one variety of tree to a street or a long portion of a street, with as many kinds as practicable in the city. The trees should be planted a proper distance apart in well-prepared holes without exposure of the roots to the air for more than a minute.

Success follows the careful planting of good trees which are given adequate protection and timely attention. Each tree should be trained to its proper form while young, so that severe pruning will not be necessary later. Guards are also necessary for several years.

Insects and diseases frequently need to be kept in check by spraying or other suitable methods.

Contribution from the Bureau of Plant Industry

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Washington, D. C.

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# PLANTING AND CARE OF STREET TREES.

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## IMPORTANCE OF SHADE TREES.

THE COMFORT to be derived from shade trees has long been recognized. The early settlers of this country saved fine trees about their homes, on the village greens, along the country roads,



FIG. 1.—An oak-shaded street in the South. Willow oaks in Birmingham, Ala., in late summer.

and in the fields. Later, as villages grew, the householders planted trees adjoining their properties, and the result has been the beautiful elm-shaded villages of New England, the maple-shaded towns of New York and the Ohio Valley, and the oak-shaded streets of the Southeastern States. (Fig. 1.)

With time, the villages and towns became cities, and the woodlands were largely destroyed. Conditions for tree growth were less favorable in the cities, and nurseries had to be depended upon for planting material. With these changed conditions the native trees of a region became less dominant in the city planting and were largely replaced by those trees listed in nursery catalogues which took the fancy of each property owner along the street. (Fig. 2.) The quickest growing trees were considered first, and as some of these made a big showing the first few years and were easily transplanted, they have become the dominating trees in street planting from the Atlantic to the Pacific and from the Great Lakes to the Gulf of



FIG. 2.—A street with mixed plantings. The trees are of different kinds, some unsuited for the purpose, planted varying distances apart, according to the inclination of the property holders. A street in Stockton, Calif., photographed in early summer.

Mexico. (Figs. 2, 11, and 14.) Better and more lasting trees (figs. 1 and 3) have been planted by a few; but the tree growth on the streets of the average town or city is ragged and unkempt in appearance, while that of the suburb or small village is not much better unless the planting has been done under municipal control and the plantings on a street have been confined to a single kind of tree.

The advent of such civilizing agencies as the telegraph, the telephone, the electric light, and the trolley car have added each its share toward the mutilation or destruction of the good trees that were in existence at the time of their coming. Faulty methods of pruning also have caused much disfigurement and ruin. (Figs. 4

and 5.) To this mutilation has been added the unnecessary destruction of many trees in centers of business (fig. 6), because they excluded a little daylight, or made a store less prominent, or were somewhat in the way of using the sidewalk for merchandise.

In spite of all these troubles tree planting has continued because people love trees, enjoy well-shaded streets, and are willing to make efforts to get them. The trees on well-shaded streets are not only pleasing, but also contribute toward the health of the community by transpiring moisture into the atmosphere and by producing a restful effect on eyes and nerves. Red, especially, is known to have an exciting effect on human beings, and where city streets are well



FIG. 3.—American elms on a city street in midsummer. All these trees were planted at one time at uniform distances apart by the Commissioners of Washington, D. C.

shaded it makes less prominent those colors that might otherwise prevail and offend.

Good shade is so appreciated that its presence adds a value to adjoining properties. Real-estate men recognize this factor and plant shade trees as early as practicable on land which they develop. That the beauty of a city is improved by good street trees is becoming recognized more and more and is finding expression in the desire of garden clubs, civic improvement associations, and boards of trade for information on this subject.

Success in planting street trees can be attained only by planning and controlling the planting as a whole, by selecting the most suitable varieties, by securing trees in the best condition and planting them properly, and by giving the necessary later care.

While towns were small, conditions for tree growth favorable, and woodlands plenty, so that native trees were easily obtained and started, the practice of each householder planting his own trees as he saw fit gave good results. As towns became larger and impervious pavements took the place of earth roads, the conditions for tree growth became more severe, and the results from the individual planting of trees less uniform. In large cities the conditions to be met are so extreme that it has become practically impossible for the average householder to grow street trees successfully, unless it be at excessive cost. Then, too, a lineman in a few minutes often undoes



FIG. 4.—Mutilated trees. Trees should be planted sufficiently far apart or enough of them should be removed to make such treatment unnecessary.

what the individual has achieved with care and years of patient waiting. (See fig. 5.) The trees and the lines are both needed by the public, but when provided by individual initiative at private expense, but trimmed for the benefit of electric lines by employees of corporations intent on maintaining service at the least cost, the trees suffer unduly.

To have good shade trees it is essential that they be given timely and efficient attention and that effective control shall be exercised over wire lines and other agencies liable to damage them. To do this effectively and at reasonable cost, the care of the trees needs to be vested in some adequate authority.

**PUBLIC CONTROL OF SHADE TREES.**

Providing shade on city streets is as much a municipal function as providing lights on sidewalks and should, therefore, be cared for by public officials. All street trees should be directly under the care of duly appointed officers, who should be responsible for their planting and care as well as for their pruning or removal. Negative control by requiring permits for planting, pruning, and removal is little better than no control.

The officials in charge should have the necessary authority and should be required to initiate and carry forward planting and all other needed work connected with the establishment and maintenance of street trees. Probably the most satisfactory way of securing supervision is through an unpaid commission of three or five members, which in turn employs an executive officer. In a small place a commission of three persons may be

best, one being appointed every two years for a six-year term. In large places five members may be better, and the ideal term would be 10 years. A compromise would be a five-year term, a new member being appointed each year. The great reason for long-term appointees is that it takes two or three years for a member of such a board or commission to see and realize the things needed to be done and the policies that should be carried out. Because it takes a long time to get results in growing street trees, the policies should be as nearly continuous as possible and the terms of the members long enough to insure a majority of experienced persons on the board at all times.



FIG. 5.—A tree mutilated by linemen. An otherwise beautiful red oak in Louisville, Ky., as it appeared in midsummer.



The method of appointing the commissioners is not so important as that each shall be selected from the territory as a whole rather than from a part of it. In some places where the term of service is 10 years, each one's successor is appointed by the remaining commissioners, subject to confirmation by the court. Where this is done a member is not permitted to succeed himself. In other places the commission is appointed by the court; in others, it is elected by the city legislative body or is appointed by the mayor subject to the approval of the legislative body. The important point is to keep the administration as nearly as possible on a purely business basis.



FIG. 6.—A desert of asphalt in the business center of a city having less than 100,000 population.

A good board can accomplish nothing without liberal funds. There are two methods of providing these: (1) By an appropriation from the general tax levy and (2) by direct assessment against the properties, collectible with the other taxes. The trees shown in figure 7 are supported by the second method. If the funds are provided by appropriation, a fixed minimum, expressed in millage of the tax rate, should be provided in the organization of the commission. This minimum should be such that a fair amount of maintenance work can be done when no other funds are available. Councils that appropriate money sometimes hamper boards by withholding appropriations. Work of the nature of tree planting should not be permitted to suffer or be lost by a year's neglect. The fund provided by this minimum amount should not be so large that regular additional

appropriations will not be needed to carry on the work properly, as this will give a desirable point of contact of the commission or board with the ordinary channels of expressing public sentiment in the district interested. The minimum appropriation mandatory should be sufficient to prevent injury from lack of care of work already begun. A period of minimum care and attention while a board and the people or their representatives are coming to a new understanding of one another's position is not necessarily a detriment, provided a reasonable maintenance has been possible in the interim, but without such care the results are ruinous, and work would better not be started



FIG. 7.—A boulevard where the expense of planting and maintaining trees is assessed against the abutting property owners and is collected with the general taxes.

than be undertaken with the possibility of such a period of neglect occurring.

It is probably desirable to assess the cost of tree planting against the adjacent property owners at a proportional cost per front foot and to provide for maintenance out of a general fund. Boulevards and other unusual developments are sometimes maintained with satisfactory results by regular assessments against the abutting properties.

After a proper governing board is provided, the securing of a competent executive is a matter of ordinary business procedure. It is usually desirable that he shall be not only a good executive but also a man with a knowledge of trees and trained in their care, so that he may be a competent adviser of the board as well as its executive.

**PLANNING FOR TREES ON CITY STREETS.**

With the help of one who knows trees and the local conditions to be met, the town should be studied and a suitable kind of tree selected for each street or for a large portion of a street (figs. 1 and 3), and as conditions warrant the plan should be carried out as outlined. Mixed plantings of different sorts of trees (figs. 2 and 8) are not as pleasing and effective as the use of a single species for considerable distances. The use of only one or two kinds for a whole town is likely to be monotonous, and it is also undesirable because the variety most used may become subject to serious disease or insect attacks. The species and varieties of trees suitable for city planting are few

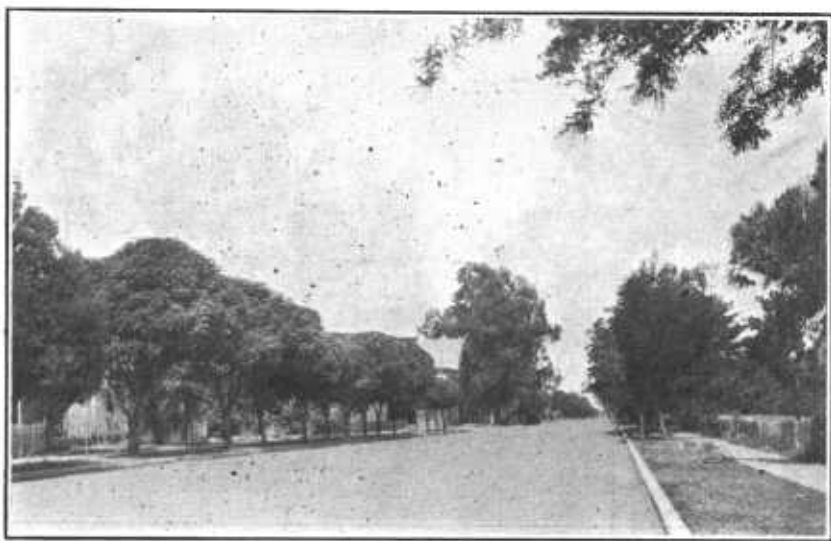


FIG. 8.—Increased attractiveness due to trees on a city street, as shown by contrasting the two sides of the thoroughfare. If trees like red oaks, American elms, or the Eucalyptus in the distance had been used, the effect on this wide street would have been comparable to figure 3. The trees in the left foreground are umbrella trees. Merced, Calif., in midsummer.

enough, if all are used, so an endeavor should be made to include as many different kinds as practicable, assigning one variety for a long stretch of street unless there is a marked change in its character, in which case a change of trees would be warranted.

Where trees are already on a street, the problem of planning for the future is frequently much complicated, especially if there are several kinds in good condition. Where there is but one good kind, gaps can be replanted with young trees of that sort. If there are poor trees of a good variety or trees of a poor or short-lived variety it would be advisable to remove these and do all the replanting at one time, so as to have the trees on the street as nearly uniform as

possible. Where there are several good varieties in good condition the sensible thing is to care for the trees that are there and then, after careful study, decide on one variety for all future plantings on that street.

### SPACING TREES.

A common fault in all street planting is to put the trees too near together. (Fig. 9.) This is more evident where the work has been done by the abutting property owners than by municipalities.

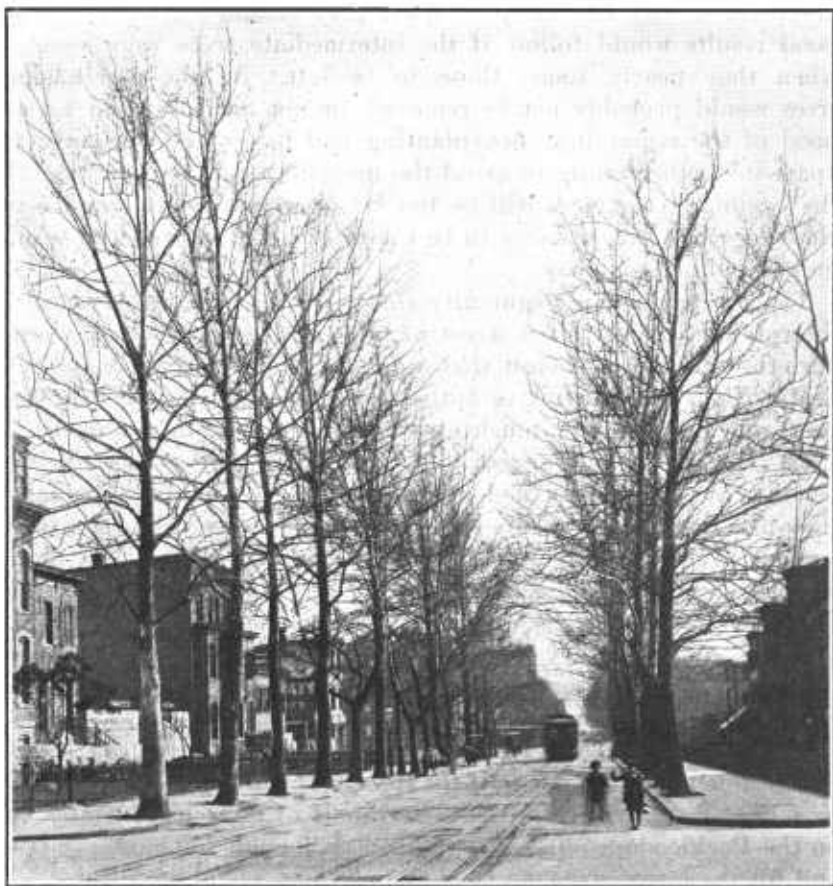


FIG. 9.—Trees 20 feet apart that should be at least 60 feet apart. Sycamores in Washington, D. C., as they appear in late winter.

After trees are started and have attained some size it is extremely difficult to get them removed, even where the good of the remaining trees demands it. The removal of a fairly good tree merely because it is short lived, in order to make room for a good one that will be permanent does not appeal to the average citizen. Where trees which have been planted by the property holder come under city

control a strong feeling of proprietorship still remains, which is outraged by the suggestion of the removal of even poor trees. Where all the work is under city control good work is often hampered by a strong public sentiment against the removal of trees, even though they are poor or crowding.

Because of this difficulty it is extremely important that young trees be planted farther apart than at that time seems reasonable. If they are planted as far apart as is proper for mature trees the distance will be so great as to make planting seem a joke. If they are planted half the distance apart they should be when mature, good results would follow if the intermediate trees were removed when they nearly touch those to be left. As the intermediate trees would probably not be removed, or not until too late for the good of the remaining ones, planting had better be sufficiently far apart in the beginning to avoid the necessity of later removals. In the beginning the trees will be too far apart and when mature too close together, but it seems to be the alternative imposed by a misguided public opinion.

There is scarcely a community that would permit the removal of interplanted trees from a street of fine elms, oaks, or other worthy varieties without a protest that would be the almost sure political death of the administrative authorities responsible, no matter how great the need or how much expert support they might have. If short-lived intermediate trees were used they would not be likely to be taken out before they died, and they probably would not die before they had irreparably injured the permanent trees. The removal of surplus or interplanted trees can be made with least shock to the community by gradually narrowing the tree tops by severe pruning from year to year on the sides next the permanent trees until finally they are so narrow they may be removed and leave only small openings between the permanent trees. Even this method will not materially lessen the public protest at the final removal.

A common practice is to set street trees 35 feet apart. If it were practicable to remove one-half the trees at the proper time this would be a good distance, but in the eastern half of the United States and on the Pacific slope 50 feet apart is close enough for most varieties, and for the larger growing trees 60 to 70 feet would be better.

### CONDITIONS FOR TREE GROWTH.

In order to grow, trees must have a soil of suitable texture, in proper mechanical condition, that contains sufficient available mineral elements and plenty of organic matter, and, last but not least, a constant supply of moisture and air. In addition to these there must be in active growth in the soil many forms of organic life that are in

various ways preparing the material in the soil for the use of the larger plants. Not only must these things be present, but others that are deleterious must be absent, whether the substance is hurtful in itself or whether it is an excess of one that is otherwise beneficial.

Above the soil three things must be present—air, sunlight, and moisture—and, as in the soil, harmful things must be absent. Among the deleterious substances are sulphur and other fumes and soot and other products from incomplete combustion.

Some of the more obvious things with which a city tree has to contend are: Water-tight pavements, both on the sidewalk and street, that prevent the admission of air and water; the removal of



FIG. 10.—The irregularity in the size of the trees shown is due to a part of the first planting having been killed by illuminating gas from defective pipes. Norway maples as seen in Washington, D. C., in late winter.

the topsoil in street grading, thus forcing the tree to exist on the good soil provided in the hole; careless digging near the tree for gas, water, and electric service, and especially for the placing of curb-stones; the saturation of the soil with illuminating or sewer gas from defective pipes (fig. 10); the pouring of salt water from ice-cream freezers into gutters, where it may find its way into the soil near tree roots; the gnawing of the trunks by horses; and the cutting of the tops by linemen and tree trimmers.

Because of the uncongenial conditions for the growth of trees on city streets comparatively few kinds are satisfactory for such use. Among those available are some that will grow under extremely

trying conditions. Kinds can be found that will thrive wherever it is suitable for human beings to live. If it is impossible to grow trees on a street, as a health measure that street should be closed for human use until conditions are so improved that it will support trees.

More kinds will thrive under suburban conditions where only a small portion of the roadway is covered by an impervious coating, where the parking spaces are liberal, and where the street is lined with open lawns than under the conditions in a city, where the street is covered with a water and air proof coating and the sidewalks with an impervious material, where parking spaces are limited, and where adjoining lawn areas are small or lacking. By a careful selection of



FIG. 11.—A business center relieved by a parking with Carolina poplars. Macon, Ga., in late summer.

kinds, all conditions in a city can be met. In some places bad conditions could have been improved greatly by a little forethought; in others, such conditions can be bettered. These details, like many other matters connected with city planning, have been ignored, but should be considered immediately, especially by villages and small cities. Figure 6 shows how an opportunity for creating a beauty spot has been lost sight of, while figure 11 shows how a city has utilized less ground to increase the comfort and attractiveness of its business center.

A common mistake in ambitious young cities and many old ones is to pave more of the width of the street for traffic purposes than is likely ever to be needed. By reducing the roadway and throwing the

remainder into liberal parking spaces much is added to the attractiveness and comfort of a city. A contrast in the two methods of treatment is illustrated in figures 12 and 13. The recommendation that the roadway prepared for travel be made narrower is not to be inter-



FIG. 12.—A street well proportioned in width of roadway, sidewalk, and parkings, with willow oaks on the left, American elms on the right, and young Carolina poplars near the roadway that should be removed. Columbus, Ga., in midsummer.



FIG. 13.—A street with too much pavement and too little parking space. Carolina poplars in Baltimore, Md., in midautumn.

preted as a reason for lessening the area dedicated to the public use; in fact, in most cities, especially in the northeastern quarter of the United States, too little space has been reserved from houseline to houseline (fig. 14). By reserving more room between the houses and the street for use as lawns and gardens the conditions would be made



more livable, opportunity would be offered for widening the public way without prohibitive expense if traffic or business demanded it, and the growing of street trees would cease to be a serious problem.

### TREES SUITABLE FOR CITY STREETS.

The kind of tree to grow on any street depends upon a large number of conditions, among which are range of temperature, moisture supply both in atmosphere and soil, type and character of soil, amount and character of street and sidewalk coverings, width of street between buildings, height of buildings, and adaptability of the different kinds of trees to the various conditions. This subject is so large that to do it justice it is discussed in another bulletin.<sup>1</sup>



FIG. 14.—A street with too little room from houseline to houseline. Note the more attractive appearance of the side with trees. Norway and silver maples in Frederick, Md., in midsummer.

### CULTURE OF STREET TREES.

#### SELECTION OF INDIVIDUAL TREES.

Nursery-grown trees should be used for street planting, and they should have been transplanted at least every two years while in the nursery. This is to insure a thorough root pruning and the production of numerous fibrous roots close to the trunk. Trees not frequently transplanted form a few long roots that are largely cut off when the tree is dug. Trees growing in the woods form a few very long roots, and when an attempt is made to dig them only a little of

<sup>1</sup> Farmers' Bulletin 1208, entitled "Trees for Town and City Streets."

the root next the trunk is obtained, while most of the roots, including the fibrous ones, are left in the ground. If woodland trees are wanted for street purposes, most kinds should be grown for a few years in a nursery so that they may form a good root system before being planted on the streets.

In addition to a good root system, the tree should have a straight trunk for the variety, with a good set of branches, called the head, the bottom branches being from 7 to 9 feet from the ground. Trees which naturally head low should be started with a higher head than those varieties that have a tendency to an upright growth. A good head for a shade tree is a leader or upright branch with three or more side branches about equally spaced around the tree. The trees should be healthy, free from scars, and also free from insects or diseases. If the presence of injurious insects is suspected the trees should be fumigated by some approved method before leaving the nursery, to insure against the introduction and distribution of pests. Weakened vitality resulting from transplanting and subsequent neglect will frequently invite attack by bark-boring insects which seriously damage or kill the trees. Mulching and watering will often prevent this damage.

Opinion as to the size to plant differs somewhat, but for average conditions trees from 10 to 12 feet high and with trunks or stems from 2 to 2½ inches in diameter<sup>2</sup> are very satisfactory in most varieties used for street purposes. With such varieties as elms, sycamores, and some southern oaks, somewhat larger trees can be used equally well, while smaller trees would be better in the regions of limited rainfall both east and west of the Rocky Mountains and for tulip trees and sweet gums, especially in the northern portion of their range of usefulness.

#### PREPARATION OF HOLES.

Next to the selection of a proper variety, the preparation of the hole is the most important detail of street-tree planting. Because of the restricted area available for the spread of the tree roots, and owing to the artificial conditions imposed by the improvement of city streets, the soil provided for the feeding ground of the roots of the young tree must be liberal in quantity and of the best quality. From 2 to 3 cubic yards of soil should be provided for each tree. It is desirable to have at least 18 square feet of opening in the sidewalk, especially if it is of concrete or other impervious material. Trees will grow with smaller sidewalk openings, but they are not likely to thrive so well, and it is impossible properly to prepare a

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<sup>2</sup> Designated by nurserymen as "caliper."

hole for planting a tree without disturbing at least this much surface soil. The proper depth of soil is from  $2\frac{1}{2}$  to 3 feet. A hole 3 feet deep large enough to hold 2 cubic yards of soil has a surface area of 18 square feet. A hole 6 feet long, 3 feet wide, and 3 feet deep will hold 2 cubic yards of soil, will have the smallest desirable surface area, and will be of such dimensions as will best conform to the usual sidewalk and roadway widths and thus not interfere with traffic.

The tree hole must be so drained that water will not stand in it. If the soil is so impervious as to hold water, some artificial drainage must be provided. That portion of the depth of a hole that acts as a cistern for holding water is valueless as a feeding ground for roots. For every cubic foot of soil in the bottom of a hole that might thus be made valueless by standing water,  $1\frac{1}{2}$  cubic feet of soil should be added by increasing the length or width of it. Under no circumstances, however, should the depth of available feeding ground be less than 2 feet. The deeper the roots may be encouraged to grow, the less injury is likely to be experienced from drought.

The soil used should be topsoil from land that has been producing good crops. This should be well enriched with rotted manure, one part of manure to four of soil. The addition of such fertilizers as ground bone, tankage, fish scrap, or cottonseed meal at the rate of 1 pound to the cubic yard of soil is also helpful. Commercial fertilizers containing mostly phosphoric acid obtained from other substances than ground bone are not to be recommended for use in the soil about the roots at planting time. When used they should form a surface application, worked into the soil after planting.

#### PLANTING.

If trees are shipped from a distance they should be taken at once on arrival to some point where the roots may be carefully covered with soil; there they should be unpacked and plenty of loose moist earth worked thoroughly around and over the roots as fast as they are taken from the box. This temporary covering of the roots is called "heeling in." (Fig. 15.) The tops may be either erect or laid almost on the ground in successive rows, the tops of one row lying over the roots of the previous rows, the object being to cover the roots thoroughly and keep them moist until the tree is wanted for permanent setting. Not a moment of exposure should be permitted between the box and the soil. If the roots appear dry, they may be dipped before heeling in for a few minutes in a tub of water or in thin mud.

Trees in large quantities are often packed directly in cars with a small quantity of straw about the roots. When shipped in this way extra care (compare figs. 16 and 17) must be exercised in taking the trees to the point where they are to be heeled in. The wagon in



FIG. 15.—Trees well heeled in. Trees are often heeled in with the trunks almost lying on the ground. If the roots are thoroughly covered this is equally as good as when placed upright, and in windy places it has the advantage of there being less danger of the trees being loosened in the ground by the wind.

which they are to be hauled should have a tight box, and wet canvas should be tied tightly over the load. The last is important, so that there may be no chance for the roots to dry.

When taking trees from the ground where they have been heeled in to the place for planting, great care must also be exercised to see that the roots are not exposed to sun or wind, but are kept closely covered with moss, wet burlap, or canvas until planted. Lack of care in this matter is a greater cause of loss in tree planting than carelessness in any other particular. One city that has its own nursery and uses largely trees that are supposed to be difficult to move, but is careful about not exposing the roots for a moment (fig. 17), has a loss of less than 1 per cent. If the roots once dry the trees will die, and it takes but a short exposure to dry the roots. The holes should be prepared well in advance of planting, so that no time will be lost when conditions are right for putting the trees in the ground.



FIG. 16.—Trees handled in a careless manner. The roots should have been covered with wet canvas.

The death of trees at the time of transplanting is due to the drying out of either roots or tops before opportunity is given them to become reestablished in their new locations. This drying may be due to improper exposure at the time of digging or before packing (fig. 16), poor packing, prolonged delay in delivery, improper handling between unpacking and planting, or the existence of conditions conducive to excessive drying out of the plant after setting.

The atmosphere is continually claiming a tribute of moisture from all living plants, whether the plant is in leaf and growing or is dormant. Growing plants, and dormant plants under normal conditions, are able to replace this moisture by absorption through the roots. In climates where newly planted trees may obtain sufficient soil water

to replace these losses by drying, fall planting is best. Where the plants are unable to get sufficient winter moisture, planting would better be done only in the spring. Where the soil freezes to a depth greater than that to which the plant roots extend, the supply of water is cut off from the roots and the tree will be killed by drying out through evaporation from the top. Where winter winds are very drying and the soil moisture is limited, evaporation from the top is likely to be in excess of that supplied by the roots and the tree is killed in the same way.

The month or six weeks just preceding freezing weather is the best time for transplanting deciduous trees in a large part of the east-

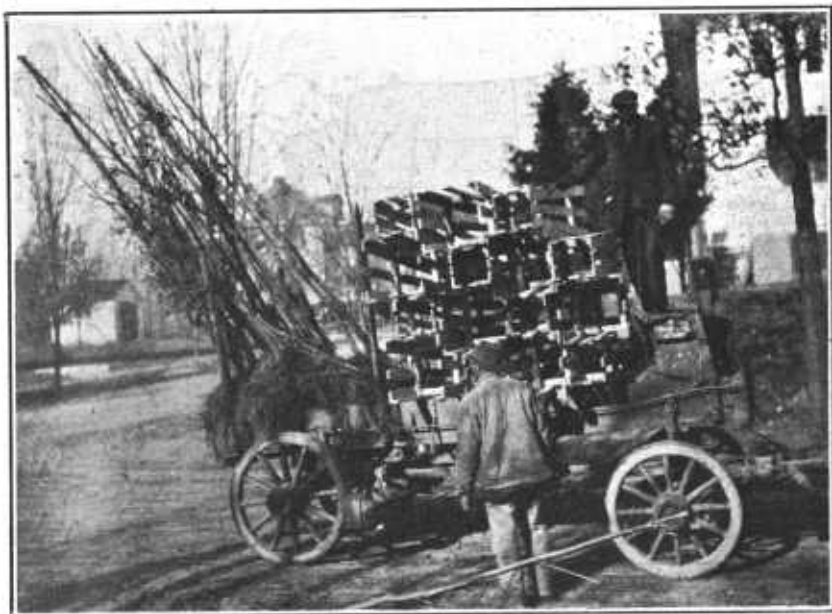


FIG. 17.—A load of trees and tree boxes. The roots are packed in wet moss and a tree is not taken from the wagon until the planter and two shovelers are at the hole where it is to be planted.

ern United States and limited areas on the Pacific coast. This region is shown as a clear area on the accompanying map (fig. 18) and includes in general the eastern third of the northern United States from Chicago eastward, except Michigan, Vermont, New Hampshire, Maine, and northern New York, and the eastern half of the southern United States as far west as eastern Texas, except the semi-tropical portions of Florida. It also includes the Puget Sound region and small portions of the coast of Oregon and California. The other desirable time for planting is as soon after freezing weather is over in the spring as the ground is dry enough for the mechanical operations. This should be as early as possible, as the more oppor-

tunity there is for root growth before warm weather forces the top into growth, the better the results are likely to be.

Spring transplanting is probably best in those portions of the country where the ground freezes to a considerable depth, where there are dry winter winds, or where there is a deficiency of moisture in the autumn. These regions are indicated by stippling on the map. If cold and not lack of moisture is the limiting factor, a heavy mulch will often permit fall transplanting where otherwise it would not be practicable. When dry winds are the cause of failure, thorough drenchings, a heavy mulch for a considerable distance around the tree, and protection of the top by burlap, straw, or other

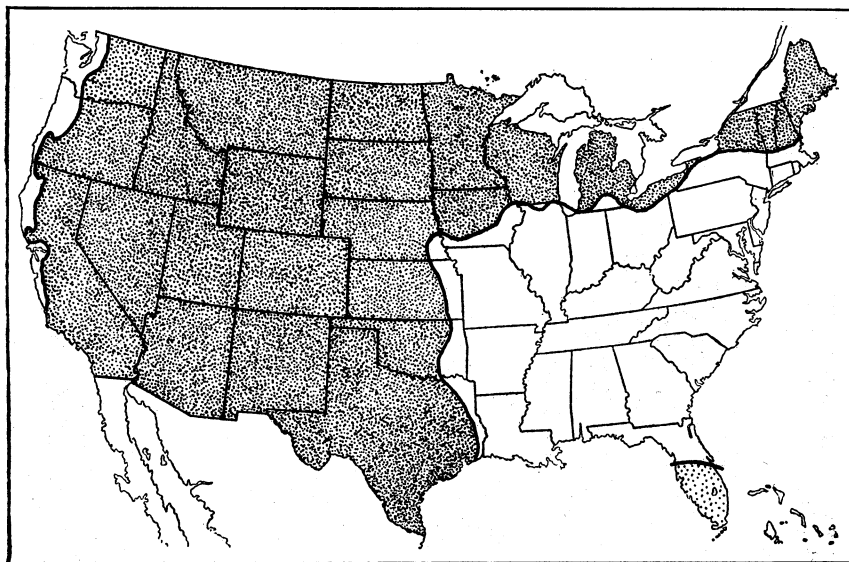


FIG. 18.—Transplanting map of the United States. The white areas indicate where fall is at least as favorable a time as spring for transplanting most trees. In the darkly stippled areas transplanting should be done only in spring unless special care is exercised. In the lightly stippled area transplanting may be done whenever moisture conditions are favorable.

wrappings may make fall transplanting possible. Mice may harbor in the mulch and girdle the tree unless prevented by a collar of wire netting about the base of the trunk or by banking earth around it.

In the almost frost-free areas indicated by light stippling on the map, transplanting may be done whenever moisture conditions are satisfactory.

In regions normally adapted to fall planting, newly set trees may be killed by a dry autumn followed by a dry winter with high winds or by a cold winter with so little snow that the ground freezes below the roots. On the other hand, trees may often be successfully planted in the fall where such practice is not usually successful by thoroughly mulching the soil if freezing is the sole cause of the difficulty, or by

drenching the soil thoroughly and then mulching well if lack of moisture and high winds are the causes of the trouble. Protection from the wind by wrapping the trunk and large limbs with burlap or some other protecting material is also desirable.

After a liberal opening has been made in the specially prepared soil the tree should be brought, preferably from the city's own nursery (fig. 19), but if such a nursery has not been provided, then from among the newly received trees that have been heeled in, as already described.

If the tree has been well handled and the roots carefully protected it is ready for setting. It is desirable to immerse the roots in a thin mixture of clay and water just before putting it in the hole if there is suspicion that the roots have been exposed. This can be done before

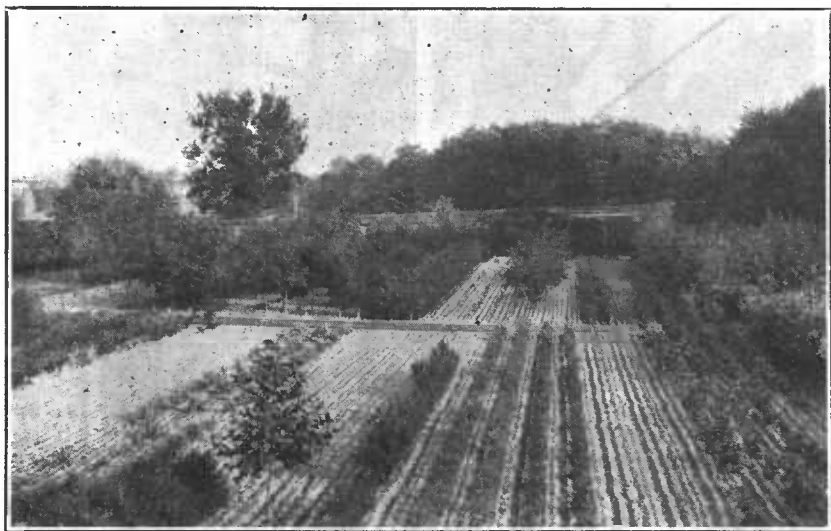


FIG. 19.—A city nursery.

leaving the nursery or heeling-in ground, but the roots must be properly protected. Any mutilated ends of roots should be removed, the top should be severely pruned, as described later, and the tree should be placed in the hole in line with the other trees (fig. 20, A) and at such a height that after the filling is completed it will be about an inch deeper in the ground than it was before transplanting. The roots should be spread out in as near their original position as practicable, and soil should be carefully worked in about them with the fingers, so that each rootlet may come in contact with soil and not be crowded against other rootlets. When all the roots have been placed and covered the soil should be thoroughly trampled or tamped to bring the roots into as close contact as possible with it. Then more soil should be put in and the ground again tamped. Of course,



in order to get satisfactory results, the soil used for planting must not be too wet or too dry. If the soil is in such a state as to hold together in soggy masses and not spring apart again when squeezed in the



FIG. 20.—Setting a tree: A, Measuring from the curb to get the tree in line; B, filling the hole; C, placing the box; D, fastening the box.

hand, it is too wet for planting. If the soil is too dry, it will not stay in contact with the roots during the planting operations. A soil that is too dry may be well watered a day or two in advance of the

planting, or if excessive dryness does not make it difficult to handle, the tree may be planted and then be thoroughly watered. After the watering 3 or 4 inches of loose soil should be spread over the wet ground in order to prevent undue evaporation. It should not be trampled or pounded in any way after the water is applied. If trees planted in moist retentive soils are watered after planting they should be provided with a mulch of similar earth. East of the Missouri River trees planted in soil that is in good condition usually do not need watering at the time of planting.

Trees planted from pots, cans, or boxes should have the ball of earth taken from the receptacle handled with care, so as not to break it further than to loosen some of the roots on the outside of the ball; then the soil should be as carefully placed about this ball and the loosened roots as about the roots of trees without balls. Trees planted with balls need no root pruning and little top pruning.

#### PRUNING.

At planting time the trees should be so pruned as to remove from one-half to three-fourths of the leaf buds. The head should be formed in the nursery, so that at planting time the only problem is how to reduce the amount of prospective growth the first season without destroying the form of the head. Specific directions are difficult, because different species of trees are so different in their character of growth. A species that is naturally compact in growth (fig. 21) should be pruned by removing whole branches rather than by having the ends of branches removed. One that is open and spreading (fig. 22) will probably need the shortening of the longer limbs as well as the removal of interior branches. The first pruning should be the removal of such branches as can be spared. If enough buds can not be removed in this way without leaving the head too open, then the shortening of the branches must follow. It is usually necessary to remove three-fourths of the limbs to accomplish this. An expert can do this pruning or most of it more easily before the tree is planted than afterwards. Some additional pruning may be necessary after the tree is set.

In addition to the pruning of the top the roots may need some cutting. Any broken pieces or ends should be removed, making a clean cut with a sharp knife, as new rootlets put out more readily from a cleanly cut fresh surface than from ragged breaks. If the roots are very long, without branches or rootlets, it sometimes makes planting easier to cut off some of the ends. As roots are the braces by which a tree is supported in the ground, it is undesirable to reduce their length unless some positive good is to be gained by it.

The best implement for cutting small limbs is a sharp knife, and for larger limbs a fine-toothed saw. Pruning shears are sometimes

used, but they are likely to bruise the wood. If used at all, the blade should always be turned toward the tree, so that the bruise made by the supporting bar will be on the portion cut off. Where branches are taken off, the cut should be close to the remaining limb, so that no suggestion of a stub will remain. (Figs. 21 and 22.) Where ends are cut from branches the cut should be just above a bud, and the remaining bud should point in the direction that it is desired the limb should grow.

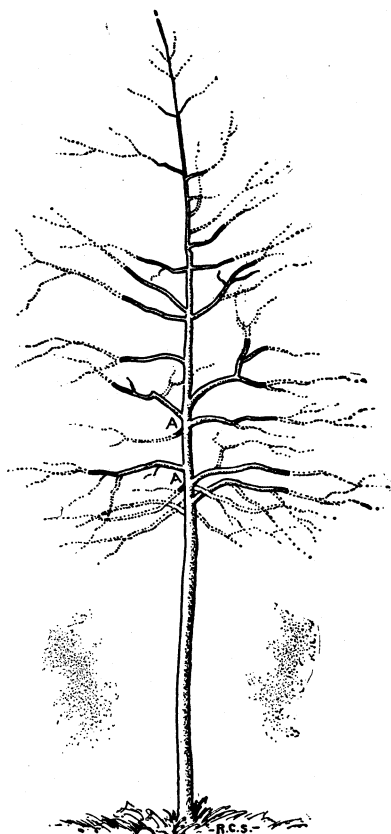


FIG. 21.—A pin oak trimmed for planting. Note the bad stubs (A, A) on the left-hand side of the tree.

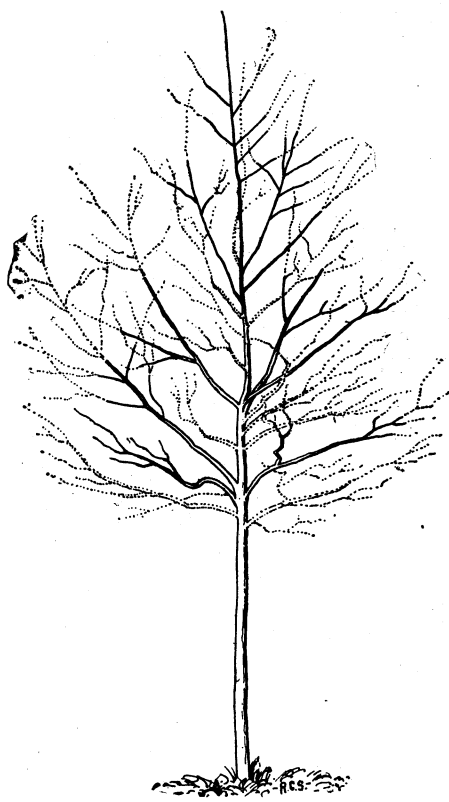


FIG. 22.—A sycamore trimmed for planting. Well pruned, without bad stubs.

#### STAKES AND GUARDS.

Under city conditions young trees need the support of a strong stake as well as protection for the trunk. Boys like to swing around small trees or see the tops fly up if bent to the ground. Men find them convenient hitching posts for their horses, and horses frequently like the taste of the bark or tear it off for the sake of having something to do.

Guards are of many forms (fig. 23), from stakes  $2\frac{1}{2}$  inches square set 3 feet in the ground and extending 6 feet above, with heavy netting placed about the tree and stapled to the stake, to heavy wooden cribs of four stakes and intermediate slats and wrought-iron forms of many patterns.

The trees should be firmly secured to the tops of the guards so that they will not swing against them in the wind and be rubbed. This is best done by securing the tree in place in the guard by two loops of pieces of old garden hose, soft leather, or rope, in such a way as not to bind the tree too tightly while keeping it from swinging much or rubbing. The essentials are a firm support for the tree while young with reasonable protection of the trunk from careless depredations until the tree has reached a diameter of 6 inches or more.

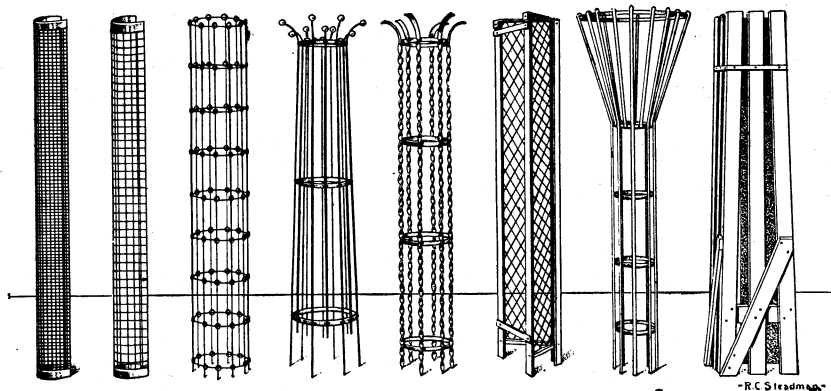


FIG. 23.—Types of tree guards.

#### LATER CARE.

If, after planting, the season is dry and it becomes necessary to apply water, the ground should be soaked thoroughly, and as soon as it has dried sufficiently to work up loosely it should be hoed or raked to make a good earth mulch. A mulch of strawy manure or litter may be used in place of the earth mulch if desired. The watering should not require repeating for a week or more.

If the weather becomes warm soon after planting and the trees come into leaf, wither, and droop, further pruning may save them. The reason for the difficulty is probably that the growth of the top has been greater than the newly formed roots can support; therefore the additional pruning is likely to restore the balance between the top growth and root growth. At least three-fourths of the remaining young wood should be removed. This may leave the tree looking almost like a bean pole, but if it induces a vigorous root growth the top can easily be re-formed.

Young trees should have an annual inspection, and all crossing branches and any that are not well placed to form a good head should be removed. Attention should be given also to all forks, and where two branches start almost parallel to one another or at a small angle, making a fork liable to split apart as the tree grows, one branch should be removed. Where three branches start from almost the same point there is little likelihood of their splitting apart, but with only two growing at a less angle than  $30^{\circ}$  there is liable to be trouble in the case of most kinds of trees. On trees on which few but long shoots form, it may be well to remove the ends of such shoots. As a rule, it is undesirable to use for street planting trees with this kind of growth. Young trees should be trained into a desirable shape by the use of a pruning knife each year, so that a saw will not be necessary later. Some trees have a tendency to form too dense a head. The interior branches of these should be removed and the head made as open as possible while the work can be done with a knife. No attempt should be made to alter the natural form of a tree, but only to insure its best development. A skillfully pruned young tree will show no evidences of the pruning after three or four years.

## CARE OF MATURE TREES.

### PRUNING.

It is very little trouble to train a tree into a good shape by using the pruning-knife while the limbs are small, but it is usually difficult to re-form a tree after it has grown to maturity. One who understands tree growth, however, can often reshape the top of a neglected tree to advantage, though many who make a business of tree trimming know so little about it that they do more harm than good. More mature trees have been hurt by severe pruning than have been helped. Of course, dead or dying wood should be removed whenever it is found, no matter what the age of the tree. This should be done by cutting off the limb back to the nearest healthy crotch. A limb should not be cut off square across (fig. 4) unless the tree is apparently in a dying condition and the whole top is treated thus in an attempt to save its life. In such a case, a second pruning should follow within two years, at which time the stubs left at the first trimming should be cut off in a proper manner near the newly started limbs. Healthy silver maples and willows are frequently cut in this way, but the maples in particular would better be cut down at once than to subject the public to the dangers of the insidious decay that almost always follows such an operation on these trees and completes their destruction promptly.

Trees that have been neglected a long time frequently have interfering or crossing branches, or are too low headed or too densely headed for the place where they are growing. Defects of this kind may be at least partially remedied. The removal of limbs by cutting them off at a crotch in such a manner that the wound is parallel with the remaining branch (fig. 24) inflicts the least possible damage. Such a wound in a healthy tree will soon heal over if the cut is made through the slight collar or ring that is nearly always present at the base of a branch. The closer this cut can be made to the trunk the better the appearance when the cut is healed. The closer the cut the larger the wound, but the difference is unimportant if the wood is well protected until it is healed. These operations are entirely different in purpose and result from the "heading in" or "heading back" so often practiced under the guise of tree pruning, either from a false notion of forming a top or for the passage of wires.

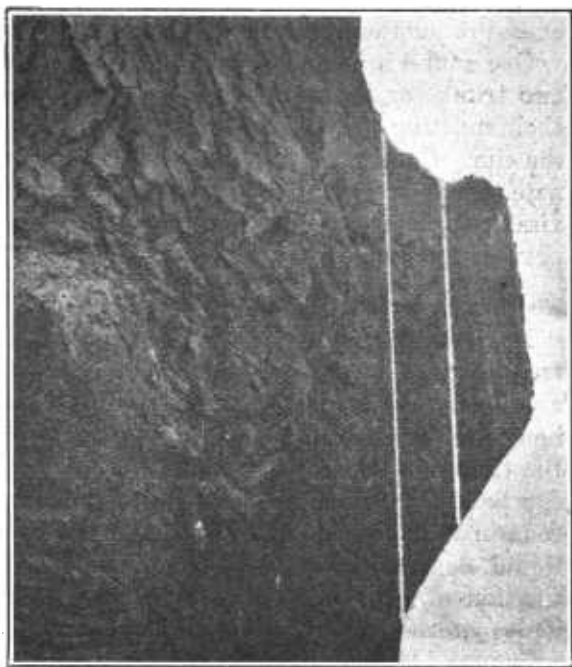


FIG. 24.—Part of a tree trunk, showing the stub of a limb that was cut too far from the tree. Had the cut been made between the white lines there would be a larger wound but it would be likely to heal much more quickly and be less conspicuous.

Changing the form of a tree by pruning should not be attempted. Each species has its own form

or forms, and no attempt should be made to change or distort a tree from its normal habit of growth. Successful pruning will accentuate rather than disguise a tree's characteristics.

All cuts should be made so that no stubs or protuberances are left to prevent quick healing. Small wounds need no after treatment if the cut is well made. Large wounds should have the wood of the center of the cut well protected to prevent decay until the new growth has had an opportunity to heal over the cut. An application made to the center of the cut to preserve the wood should not be permitted to come near the cambium layer or inner bark, especially of soft-

wooded trees like the tulip and magnolia, as the oil or other substances contained in the paint, tar, or other covering may spread to the cambium layer and kill it. It is well not to make any application within half an inch of the outside of the wound unless the coating has been thoroughly tested.

Dead wood should be entirely removed, the cut being made through good live tissue. Removing such wood frequently exposes decayed cavities, usually from bad stubs or injuries which have started decay that has followed back to the main limbs or the trunk. The treatment of such cavities is the province of tree surgery and is discussed in another publication.<sup>3</sup>

One source of trouble with a large tree that has developed with two trunks or branches instead of three or more is the liability of their splitting apart in the crotch. This is especially characteristic of the elm. Careful attention to the early pruning of trees may eliminate this defect, but when it exists in mature trees it is frequently advisable to connect the branches by a strong chain (fig. 25) in order to prevent the limbs from being torn apart.

#### FEEDING.

It is difficult to do anything to stimulate the growth of street trees after they are once started, because usually the only uncovered area over the roots is the small opening immediately about the tree; hence, the importance of supplying the best of soil well enriched at the time of planting. Sometimes a stimulation is desirable, which can be accomplished by dissolving one-half to 1 pound of nitrate of soda in 50 gallons of water and applying from 1 to 25 gallons of the liquid, depending on the size of the tree. Unless the soil is damp at the time of application, water will be needed immediately afterward. This material should be applied only when the tree is in full leaf and growing. If applied when the tree is dormant it is likely to be leached from the soil before it is absorbed. If applied late in the season, that is, within three months of freezing weather, it would likely stimulate a late growth that would be liable to be killed the following winter and might make the whole tree more susceptible to injury from cold.

Water is one of the great needs of city trees, as the ground surface is often almost completely roofed over with water-tight coverings. It is usually a help for the pavement washings to drain into the parking space where the tree is planted. If a curb is placed about the parking space, frequent, regular watering is necessary where the ground is thoroughly covered with water-tight pavements.

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<sup>3</sup> Collins, J. F. Practical tree surgery. In U. S. Dept. Agr. Yearbook, 1913, pp. 163-190, pl. 16-22. Published as Yearbook Separate 622, obtainable from the Superintendent of Documents for 10 cents in coin. Revised as Farmers' Bulletin 1178, entitled "Tree Surgery," obtainable on request from the United States Department of Agriculture.

Where growing under suburban conditions, that is, with streets partially pervious to water, liberal parking spaces, and adjoining lawns, street trees will respond to all extra care given the near-by

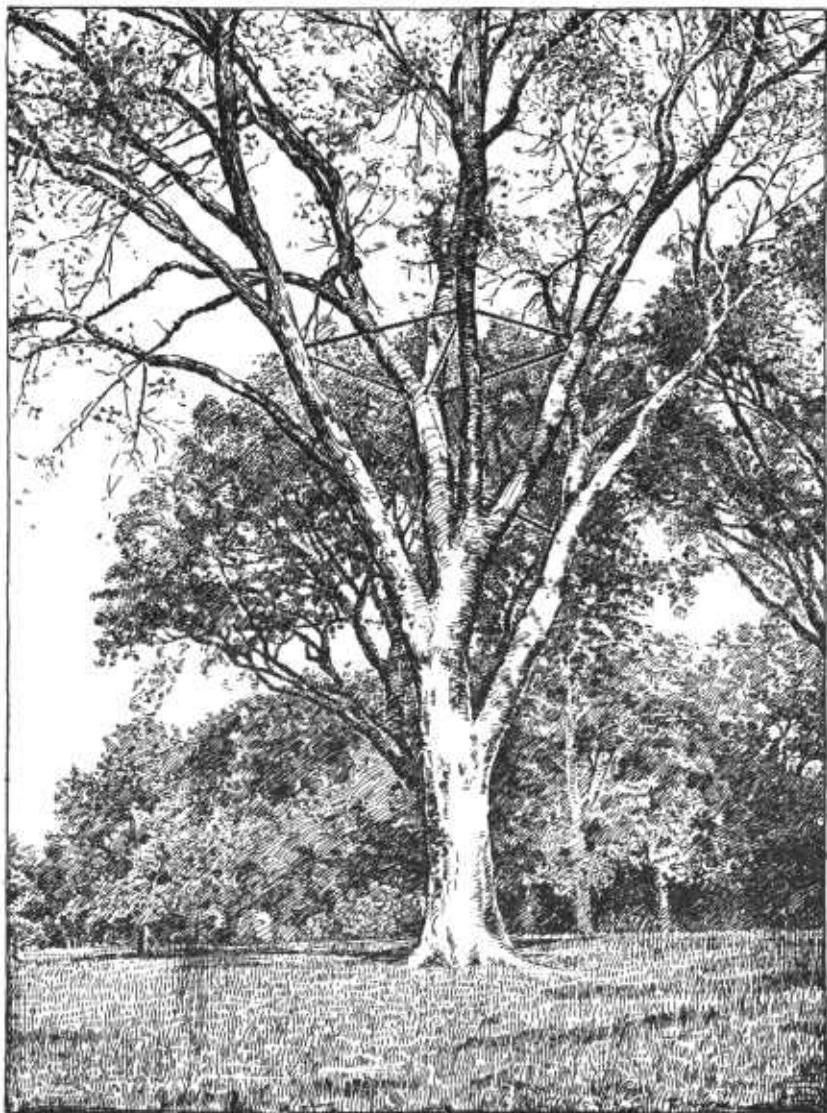


FIG. 25.—An American elm with crotches liable to be split by heavy winds. Note the supporting chains.

open spaces, whether parkings, lawns, or gardens. If these are well cared for the trees should have ample sustenance from them without any direct applications.



In order to prevent the soil about a tree from being packed too hard by trampling it is frequently desirable on business streets to cover the soil about it with an iron grating.

#### SPRAYING.

Street trees, like all other forms of vegetation, are subject to attacks of insects and diseases. Because of the unfavorable conditions under which they grow, spraying for biting and sucking insects and suitable treatment for borers or other burrowing insects require especially careful attention.

In addition to a number of troubles common to street trees in general, each species is liable to troubles of its own; hence, the need of competent supervision by a trained man with an efficient outfit rather than to leave the work to individual initiative.

Because of the height which many street trees attain a powerful outfit is required to spray them carefully. One capable of maintaining a pressure of 200 pounds per square inch is desirable. The type of spray required for tall trees is different from that used on fruit trees and other low plants. For low trees the ideal spray is a mist within a few feet of the nozzle, application being accomplished by having the nozzles near the foliage to be treated. For tall trees it is desirable that the liquid should leave the nozzle in a solid stream, which is broken into spray as it passes through the air. The material has to be projected with sufficient force to reach the highest trees before being entirely converted into mist, as it is impracticable to extend the nozzles into the trees to reach the farthest portions, as is done with fruit and other low trees. The spray can not be applied as uniformly as a mist, but it is impracticable to climb into the tops of shade trees to cover every part with a cloudlike spray. On the other hand, the mist spray is better for small trees, as much injury may be done to low trees or to the lower branches of high trees by the force of the stream from high-pressure outfits.

It is estimated that in practice up to 95 per cent of the attacking insects can be killed with insecticides carefully applied by the stream method under high pressure.

In addition to the mechanical problem of satisfactorily covering high trees with insecticides or fungicides, there is the problem of selecting materials that will be effective against the insects and diseases and at the same time will not disfigure the paint or stone work of adjacent buildings with which the materials must inevitably come in contact in street-tree spraying. It frequently happens that the most effective remedies must be rejected because of the damage they would do to buildings and that less efficient materials must be used.

Whitewashing the trunks of trees is a useless and unsightly practice—useless, as it does not prevent the attacks of insects, and unsightly because it makes the trunks of the trees obtrusive when they should be inconspicuous.

Banding with cotton or proprietary preparations may occasionally be useful, but because such applications are so seldom helpful and because some of the preparations result in injury due to constriction of the trunks, it should not be resorted to except upon special recommendation of an entomologist familiar with the existing conditions.

Details as to enemies to be expected, methods of treatment, and materials to be used may be found in other publications<sup>4</sup> or may be obtained by correspondence with the nearest State agricultural experiment station or with the United States Department of Agriculture.

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<sup>4</sup> See list on following pages.

**PUBLICATIONS OF THE UNITED STATES DEPARTMENT  
OF AGRICULTURE RELATING TO DISEASES AND IN-  
SECTS AFFECTING SHADE AND ORNAMENTAL TREES.**

**AVAILABLE FOR FREE DISTRIBUTION.**

Control of Root-Knot. (Farmers' Bulletin 648.)  
The San Jose Scale and Its Control. (Farmers' Bulletin 650.)  
The Bagworm, an Injurious Shade-Tree Insect. (Farmers' Bulletin 701.)  
The Catalpa Sphinx. (Farmers' Bulletin 705.)  
The Leopard Moth: A Dangerous Imported Enemy of Shade Trees. (Farmers' Bulletin 708.)  
The Oyster-Shell Scale and the Scurfy Scale. (Farmers' Bulletin 723.)  
Carbon Disulphid as an Insecticide. (Farmers' Bulletin 799.)  
The Gipsy Moth and the Brown-Tail Moth and Their Control. (Farmers' Bulletin 845.)  
Common White Grubs. (Farmers' Bulletin 940.)  
Tree Surgery. (Farmers' Bulletin 1178.)  
The Blights of Coniferous Nursery Stock. (Department Bulletin 44.)  
Forest Disease Surveys. (Department Bulletin 658.)

**FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERN-  
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The White-Pine Blister Rust. (Farmers' Bulletin 742.) Price, 5 cents.  
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- The San Jose or Chinese Scale. (Entomology Bulletin 62.) Price, 25 cents.  
Report on Field Work against the Gipsy Moth and the Brown-Tail Moth.  
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and the Brown-Tail Moth. (Entomology Bulletin 91.) Price, 65 cents.  
The Dispersion of the Gipsy Moth. (Entomology Bulletin 119.) Price,  
20 cents.  
The Green-Striped Maple Worm. (Entomology Circular 110.) Price, 5 cents.  
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nal of Agricultural Research, vol. 1, No. 2.) Price, 25 cents.  
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(Journal of Agricultural Research, vol. v, No. 17.) Price, 10 cents.  
The Chestnut Bark Disease. (Separate 598, from Yearbook of the Department  
of Agriculture for 1912.) Price, 10 cents.  
Practical Tree Surgery. (Separate 622, from Yearbook of the Department of  
Agriculture for 1913.) Price, 10 cents.  
Forest Tree Diseases Common in California and Nevada. (Forest Service Un-  
numbered Publication.) Price, 25 cents.